

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	East- ern stand- ard time	Mt. Wilson group No.	Heliographic			Area		Spot count	Observatory
			Diff. in longi- tude	Longi- tude	Latitu- de	Spot or group	Total for each day		
June 21...	h m 13 8	5942	-37.0	311.2	+7.0	24	-----	4	U. S. Naval.
		5943	-15.0	333.2	-25.0	24	-----	7	
		5945	-15.0	333.2	+22.0	73	-----	16	
		5947	-13.0	335.2	+13.0	48	-----	10	
		5939	-12.0	336.2	+6.0	970	-----	50	
		5945	-8.0	340.2	-20.0	24	-----	6	
		5934	+37.0	25.2	+6.0	339	-----	5	
		5953	+51.0	39.2	+16.0	24	-----	2	
		5944	+53.0	41.2	+20.0	97	1,623	6	
June 22...	13 27	5948	-2.0	332.8	-25.0	12	-----	1	Do.
		5946	-0.5	334.3	+22.0	291	-----	22	
		5939	+1.5	336.3	+6.0	824	-----	62	
		5947	+2.0	336.8	+13.0	12	-----	1	
		5945	+7.0	341.8	-20.0	48	-----	7	
		5934	+50.5	25.3	+5.0	388	-----	1	
		5944	+65.0	39.8	+20.0	16	1,591	3	
June 23...	11 12	(*)	-11.0	311.8	+7.0	6	-----	3	Do.
		5946	+12.0	334.8	+22.0	436	-----	20	
		5939	+14.0	336.8	+6.0	679	-----	50	
		5945	+19.0	341.8	-20.5	97	-----	7	
		5949	+41.5	4.3	+6.0	6	-----	2	
		5934	+63.0	25.8	+5.0	388	1,612	2	
June 24...	10 28	5951	+11.0	321.0	+7.0	12	-----	2	Do.
		5946	+24.0	334.0	+22.0	485	-----	25	
		5939	+26.0	336.0	+6.0	533	-----	45	
		5945	+32.0	342.0	-20.0	48	-----	6	
		5950	+39.0	349.0	-7.0	12	-----	2	
		5934	+77.0	27.0	+5.0	388	1,478	1	
June 25...	11 3	5952	+9.0	305.4	+7.0	6	-----	1	Do.
		5946	+37.0	333.4	+22.0	436	-----	20	
		5939	+40.0	336.4	+6.0	533	-----	32	
		5945	+43.0	339.4	-21.0	48	-----	7	
		5950	+53.0	349.4	-8.0	24	1,047	4	
June 26...	13 8	5957	-81.0	201.0	-11.5	291	-----	7	Do.
		5956	-60.0	222.0	+27.0	48	-----	6	
		5955	-48.0	234.0	-8.0	6	-----	1	
		5954	-12.5	269.5	+19.0	48	-----	4	
		5953	-3.0	279.0	-8.0	12	-----	2	
		5946	+52.0	334.0	+22.0	436	-----	16	
		5939	+55.0	337.0	+6.0	436	1,277	11	
June 27...	9 5	5962	-78.0	193.0	-7.0	194	-----	1	Mt. Wilson.
		5957	-69.0	202.0	-11.0	436	-----	15	
		5961	-58.0	213.0	-21.0	48	-----	5	
		5956	-50.0	221.0	+27.0	73	-----	14	
		5960	-33.0	238.0	+3.0	36	-----	5	
		5959	-27.0	244.0	-7.0	48	-----	10	
		5954	+1.0	272.0	+20.0	48	-----	2	
		5953	+8.0	279.0	-7.0	36	-----	6	
		5946	+65.0	336.0	+24.0	533	-----	12	
		5939	+69.0	340.0	+7.0	436	1,888	14	
June 28...	8 58	5962	-64.0	193.8	-7.0	194	-----	1	Do.
		5957	-55.0	202.8	-10.5	436	-----	20	
		5961	-45.0	212.8	-21.0	242	-----	8	
		5956	-37.0	230.8	+27.0	121	-----	14	
		5960	-18.0	238.8	+3.0	36	-----	9	
		5959	-13.0	244.8	-7.0	61	-----	10	
		5954	+14.0	271.8	+19.0	36	-----	2	
		5946	+78.0	335.8	+23.0	436	-----	5	
		5939	+79.0	336.8	+7.0	97	1,659	5	

*Not numbered.

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	East- ern stand- ard time	Mt. Wilson group No.	Heliographic			Area		Spot count	Observatory
			Diff. in longi- tude	Longi- tude	Latitu- de	Spot or group	Total for each day		
June 29...	h m 10 58	5966	-69.0	174.5	-25.0	6	-----	1	U. S. Naval.
		5962	-48.0	195.5	-7.5	194	-----	1	
		5957	-39.5	204.0	-12.0	436	-----	40	
		5961	-30.0	218.5	-22.0	533	-----	28	
		5956	-23.0	220.5	+27.0	145	-----	11	
		5960	-3.0	240.5	+3.0	36	-----	9	
		5959	+4.0	247.5	-7.0	97	-----	13	
		5954	+32.0	275.5	+17.0	24	-----	2	
		5965	+35.0	278.5	-7.0	6	-----	2	
		5964	+58.0	301.5	-7.0	6	-----	3	
June 30...	11 11	5963	+66.0	309.5	+9.0	97	-----	7	Do.
		5946	+88.0	331.5	+22.0	48	1,628	2	
June 30...	11 11	5962	-34.5	195.6	-8.0	194	-----	1	Do.
		5957	-25.0	205.1	-11.5	436	-----	46	
		5961	-16.0	214.1	-22.0	533	-----	37	
		5956	-10.0	220.1	+27.0	145	-----	11	
		5960	+10.0	240.1	+3.0	36	-----	4	
		5959	+17.0	247.1	-7.0	97	-----	11	
		5963	+78.0	308.1	+9.0	12	1,453	2	

Mean daily area for 30 days=1,307.

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR JUNE 1938

[Dependent alone on observations at Zurich]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich Switzerland]

June 1938	Relative numbers	June 1938	Relative numbers	June 1938	Relative numbers
1-----	113	11-----	b 106	21-----	Ec 103
2-----	a 100	12-----	99	22-----	ab 101
3-----	a 107	13-----	d ---	23-----	98
4-----	103	14-----	---	24-----	87
5-----	d 91	15-----	87	25-----	76
6-----	Eac 84	16-----	d 76	26-----	72
7-----	Mc 134	17-----	76	27-----	EEccdd 108
8-----	Wac 139	18-----	a 56	28-----	106
9-----	115	19-----	69	29-----	128
10-----	a ---	20-----	76	30-----	119

Mean, 27 days=97.4.

a= Passage of an average-sized group through the central meridian.

b= Passage of a large group or spot through the central meridian.

c= New formation of a group developing into a middle-sized or large center of activity; E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.

d= Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in Charge]

By B. FRANCIS DASHIELL

Mean free-air data, for the month of June 1938, based on a total of 817 airplane and radiometeorograph observations, are given in table 1. This information includes the basic meteorological elements of barometric pressure (P), temperature (T), and relative humidity (R.H.), recorded at certain geometric heights.

These "means" are computed by the customary method of differences, and are omitted when less than 15 observations have been made at the surface and less than 5 at a standard height. However, at those standard heights within the limits of the monthly vertical range of the tropopause, at least 15 observations are required. Further details will be found under "Aerological Observations," appearing in the January 1938, MONTHLY WEATHER REVIEW.

Chart I, published elsewhere in this REVIEW, shows the departures of mean surface temperatures from normal during June. These departures were moderate over most of the United States, but reached above-normal maxima over the Northwestern States (except on the Pacific coast itself), the northern Rocky Mountains, New England, and western Texas. The greatest departure above normal was +4.1° F. at Walla Walla, Wash. In the southeastern states and Ohio Valley temperatures were slightly below normal, as compared to an above-normal departure in May; the largest departure below normal (-3.1° F.) occurred at Pittsburgh, Pa.

The highest mean free-air temperature (°C.) for June (table 1) prevailed over Kelly Field, Tex., at the surface; over Pensacola, Fla., at 0.5 kilometer; Oklahoma City,

Okl., and Kelly Field, Tex., at 1 kilometer; El Paso, Tex., at 1.5, 2, 2.5, 3, and 4 kilometers; and over Kelly Field, Tex., at 5 kilometers. The highest temperature recorded at any level above the surface was 23.1° C. over Kelly Field, Tex., at 0.5 kilometer.

Low temperatures existed generally over the northern and northeastern states, but were seasonally warmer than during the preceding month of May. Temperatures for the entire United States were lowest over Sault Ste. Marie, Mich., at all levels, except 4 kilometers, and a minimum of -10.4 °C. was reached at 5 kilometers. The lowest at 4 kilometers occurred over Lakehurst, N. J. Temperatures at all stations were higher than those observed the previous month; the closest approach to the May temperature being over Burbank, Calif., at 0.5 kilometer.

The mean free-air barometric pressures (in millibars) are shown in table 1. Entered on an isobaric chart they indicated that a statistical center of low atmospheric pressure prevailed east of the north-central states. It was located over Sault Ste. Marie, Mich., at all levels above 1 kilometer. During the preceding month of May this center was located more to the east, over Boston, Mass., but in June it was identical to the condition which prevailed in April, except that June pressures generally were higher.

In the lower levels a low-pressure area also was centered over Burbank, Calif. A slight tendency toward low pressure was noted over Salt Lake City, Utah, up to 3 kilometers. A belt of low pressure at 5 kilometers extended in an east-west direction across the United States from Boston, Mass., to Spokane, Wash., and from Washington, D. C., to Oakland, Calif. High pressures existed generally over the southeast at all levels up to 2.5 kilometers, particularly over Norfolk, Va., Maxwell Field, Ala., and Pensacola, Fla. Above 2.5 kilometers high pressures prevailed farther to the southwest; over Barksdale Field, La., Kelly Field, Tex., and El Paso, Tex. Pressure also was high over Seattle, Wash., up to 2 kilometers, and only relatively high above that level.

The free-air relative humidity, shown in table 1, was lowest at the surface over the southern Rocky Mountain region; over the upper Mississippi Valley at 0.5 kilometer; over California and the Middle Atlantic States at 1 and 1.5 kilometers; over the southwestern and southeastern States at 2 and 2.5 kilometers; over the entire far west, and southeastern and upper Mississippi Valley States at 3 kilometers; and over southern California, Florida, and the Great Lakes at 4 and 5 kilometers. These were marked changes from those existing in May when humidities were lowest over western Texas and the Middle Atlantic States at all levels.

During June the lowest humidities recorded at all levels above 1 kilometer were found in California over Oakland, Burbank, and San Diego. Above 3 kilometers the humidity was also low over Pensacola, Fla., and Maxwell Field, Ala. High humidities prevailed over the north Atlantic States (Boston, Mass., Lakehurst, N. J., and Washington, D. C.) at all levels, and over the Rocky Mountains at 4 kilometers (Billings, Mont.) and 5 kilometers (Cheyenne, Wyo.).

Free-air resultant wind directions and velocities, based on pilot-balloon observations made near 5 a. m. (75th meridian time), during the month of June 1938, are shown in table 2. While these resultants indicated a generally normal trend over most of the United States, there were several noteworthy exceptions.

Over the Pacific northwest sharp departures from normal resultant directions at all levels occurred over Medford, Oreg., and Seattle, Wash. The former was outstanding for the entire country. Elsewhere, unusual departures were noted at Houston, Tex., Sault Ste. Marie, Mich., Pensacola, Fla., Newark, N. J., and Albuquerque, N. Mex. On the other hand, at Omaha, Nebr., Chicago, Ill., and Cheyenne, Wyo., small departures were recorded, and the resultant winds remained very close to the normal at all levels.

Greatest variations in direction at all levels shifted from Seattle, Wash., where they were recorded in May, south to Medford, Oreg., in June. At the surface the resultant wind was south of normal, i. e., when considered as being rotated in a counterclockwise direction. But between 0.5 and 1 kilometer, the wind became normal, then, up to 5 kilometers, all directions were north of normal when rotated in a clockwise direction. Above 1 kilometer a uniform northerly increase in departure from normal was noted at all levels until there was a difference of 123° at 2.5 kilometers. These resultant directions for June, at all levels beginning with the surface, were: 235°, 273°, 303°, 338°, 14°, 10°, 290°, 293°, and 292°, as compared to the established normals of 287°, 283°, 299°, 305°, 288°, 247°, 241°, 257°, and 264°, respectively.

At Seattle, Wash., departures occurred at 1 and 1.5 kilometers, where differences of 103° and 74°, respectively, were noted. Resultant departures at Seattle, Wash., during June were greater, or north of normal, at all levels. A large southerly departure from normal occurred over San Diego, Calif., at 0.5 kilometer, but resultant winds for levels exceeding 1 kilometer could not be obtained in June. Elsewhere in the United States all observations reached 3 kilometers; only 9 stations failed to reach 5 kilometers.

Pensacola, Fla., had northerly departures from normal between the 0.5- and 2.5-kilometer levels. But, over Key West, Fla., all departures were south of normal up to 2 kilometers, and then north of normal up to 5 kilometers. At Newark, N. J., and St. Louis, Mo., all June resultants were north of normal when rotated clockwise, and at Boston, Mass., Atlanta, Ga., Billings, Mont., and Cheyenne, Wyo., they were south of normal when rotated counterclockwise.

Greatest differences in resultant directions from the normal occurred at Sault Ste. Marie, Mich., on the surface; over San Diego, Calif., at 0.5 kilometer; over Seattle Wash., at 1 kilometer and 1.5 kilometers; over Albuquerque, N. Mex., at 2 kilometers; over Medford, Oreg., at 2.5 and 3 kilometers; over Newark, N. J., at 4 kilometers; and over Houston, Tex., at 5 kilometers. Of all the resultant winds for June over the United States, 36 percent were from an easterly direction at the surface, tapering off to 4 percent at 2.5, 3, and 4 kilometers. At 5 kilometers all directions were westerly, but divided equally between the southwest and northwest quadrants.

Resultant wind velocities for June were slightly above normal over the Pacific Coast States up to 2.5 kilometers, then below normal at the higher levels. They were above normal, too, in the South, except over Houston, Tex., at all levels, and below normal over the North Atlantic States above 0.5 kilometer. These velocities were below normal almost generally elsewhere at and above 1 kilometer, except over Salt Lake City, Utah, and Albuquerque, N. Mex., at 5 kilometers. The largest

below-normal departures in wind velocities were noted over Newark, N. J., at 2, 2.5, 3, and 4 kilometers; at 3 kilometers the difference being 5.9 m. p. s., the greatest for the United States. Other marked departures in velocity above the 2 kilometer level occurred over Boston, Mass., Sault Ste. Marie, Mich., Washington, D. C., and Pensacola, Fla.

Maximum wind velocities are shown in table 3. At Modena, Utah, on the 19th, a velocity of 63.3 m. p. s. from the south was observed at 2,470 meters, and at 30 meters higher (2.5 kilometers) a velocity of 58 m. p. s. High velocities also were recorded over northern stations between Spokane, Wash., and Boston, Mass., on the 7th and 8th.

TABLE 1.—Mean free-air barometric pressure (*P*) in mb., temperature (*T*) in °C., and relative humidities (*R. H.*), in percent, obtained by airplanes and radiometeorographs during June 1938

Stations	Altitude (meters) m. s. l.																											
	Surface			500			1,000			1,500			2,000			2,500			3,000			4,000			5,000			
	Number of obs.	P	T	R. H.	P	T	R. H.	P	T	R. H.	P	T	R. H.	P	T	R. H.	P	T	R. H.	P	T	R. H.	P	T	R. H.			
Barksdale Field, La. ¹ (52 m)	29	1,010	22.1	91	959	22.7	73	905	20.2	72	854	17.3	71	805	14.5	62	758	11.8	57	714	9.0	54	632	2.9	49	---	---	---
Billings, Mont. ² (1,090 m)	29	891	14.4	69	---	---	---	---	---	---	849	15.5	52	800	12.7	51	753	9.3	55	709	6.1	57	626	-0.3	57	552	-7.2	56
Boston, Mass.* (5 m)	24	1,014	16.8	84	957	16.3	74	903	14.1	70	851	11.3	67	801	8.3	61	753	5.6	58	708	3.1	54	626	-2.0	48	551	-7.2	42
Cheyenne, Wyo. ² (1,873 m)	29	813	10.9	79	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Coco Solo, C. Z. ³ (15 m)	22	1,009	24.7	95	955	23.4	86	902	20.9	85	851	18.3	34	802	15.8	82	756	13.5	76	712	11.0	72	631	4.8	74	558	-1.7	81
El Paso, Tex. ¹ (1,193 m)	30	880	22.4	46	---	---	---	---	---	---	850	22.9	42	802	20.3	41	756	16.9	42	713	13.3	43	632	4.9	48	538	-3.2	56
Fargo, N. Dak. ² (274 m)	30	981	13.8	84	955	16.5	64	901	14.7	59	849	12.3	59	799	9.2	60	752	6.4	57	707	3.5	53	624	-1.9	47	550	-7.9	47
Kelly Field, Tex. ¹ (206 m)	16	991	24.9	80	959	23.1	88	905	20.5	78	853	18.2	70	805	15.3	67	758	12.4	58	714	9.3	57	632	3.1	57	559	-2.9	66
Lakehurst, N. J. ³ (39 m)	19	1,012	17.1	86	958	18.3	66	903	15.0	63	851	11.4	65	802	7.6	62	754	4.8	58	709	1.8	62	624	-5.0	58	---	---	---
Maxwell Field, Ala. ¹ (52 m)	29	1,010	22.4	82	960	22.7	63	906	19.3	68	855	16.1	66	806	12.8	66	758	9.7	62	714	7.3	51	631	1.5	47	557	-4.3	35
Mitchel Field, N. Y. ¹ (29 m)	25	1,013	17.0	91	959	17.8	68	904	15.9	66	852	13.0	65	803	9.8	67	755	6.9	66	710	4.3	66	628	-0.6	57	---	---	---
Nashville, Tenn. ² (180 m)	30	995	19.3	87	959	21.2	68	905	18.6	72	853	15.4	73	804	12.7	62	757	10.1	55	713	7.1	54	631	1.0	52	556	-4.9	45
Norfolk, Va. ³ (10 m)	21	1,019	20.8	89	963	20.7	65	909	18.5	58	856	15.7	58	805	12.6	61	760	9.9	59	716	7.2	55	632	0.4	53	558	-6.0	41
Oakland, Calif. ² (2 m)	30	1,013	12.7	85	955	13.9	76	901	20.7	39	849	18.7	32	801	15.4	32	754	11.7	32	710	8.4	33	627	1.0	38	554	-6.1	40
Oklahoma City, Okla. ² (391 m)	30	970	20.5	86	958	21.9	73	904	20.5	68	853	17.7	71	805	15.1	65	757	12.2	61	713	9.3	57	631	2.7	54	557	-4.0	45
Omaha, Nebr. ² (300 m)	30	980	18.6	80	957	20.0	69	903	18.5	63	852	15.6	64	802	12.5	65	755	9.9	62	711	7.1	59	628	0.9	56	555	-5.6	50
Pearl Harbor, T. H. ³ (6 m)	30	1,016	22.2	83	960	20.9	77	906	17.9	81	853	15.5	76	805	13.7	64	757	12.3	51	713	10.8	38	632	7.0	28	546	2.5	26
Pensacola, Fla. ³ (13 m)	26	1,016	22.3	94	961	23.0	72	908	20.1	68	856	16.5	68	807	13.3	67	759	10.8	56	715	8.3	45	632	2.4	39	558	-3.6	35
St. Thomas, V. I. ³ (8 m)	29	1,018	26.5	75	962	21.4	83	908	17.9	86	856	15.1	82	808	13.2	72	760	11.4	57	716	8.5	53	631	2.6	51	550	-3.2	52
Salt Lake City, Utah. ² (1,288 m)	30	869	15.7	54	---	---	---	---	---	---	848	19.1	42	800	16.9	39	753	13.3	40	710	9.8	42	628	2.2	51	554	-5.3	56
San Diego, Calif. ² (10 m)	28	1,013	17.3	79	956	13.5	88	902	16.8	61	850	18.2	41	802	16.4	31	755	13.3	28	711	10.2	26	639	3.9	24	556	-3.5	24
Sault Ste. Marie, Mich. ² (221 m)	30	988	10.8	90	956	13.2	70	900	11.0	70	847	8.6	69	798	5.4	72	749	3.0	70	705	1.0	57	621	-4.2	46	547	-10.4	43
Scott Field, Ill. ¹ (135 m)	24	1,002	17.1	89	960	19.8	63	905	16.9	63	853	13.8	66	804	11.2	63	757	9.1	55	712	6.7	50	629	0.6	50	556	-5.4	35
Seattle, Wash. ³ (10 m)	19	1,018	17.9	59	961	12.9	72	906	12.2	60	853	10.8	52	803	8.3	53	755	5.9	47	711	3.3	43	621	-2.7	45	---	---	---
Selfridge Field, Mich. ¹ (177 m)	30	994	15.1	84	957	17.5	64	903	14.7	64	850	11.2	69	801	8.2	70	753	5.5	65	709	3.4	57	625	-1.5	52	551	-7.5	49
Spokane, Wash. ² (597 m)	30	944	13.6	72	---	---	---	---	---	---	849	14.7	47	800	11.3	50	753	8.2	50	709	5.1	52	625	-1.1	49	552	-7.2	45
Washington, D. C. ³ (13 m)	29	1,016	18.6	84	958	17.2	73	904	15.3	67	851	12.6	66	803	9.4	69	754	6.9	70	711	4.4	68	627	-1.6	60	552	-7.5	53
Wright Field, Ohio ¹ (244 m)	29	987	15.7	87	958	18.1	71	903	16.8	66	852	13.6	70	802	10.9	65	755	8.1	64	711	6.0	52	628	0.6	47	554	-5.2	45
Burbank, Calif. ² (220 m)	30	987	13.5	90	954	13.1	87	900	15.8	82	849	15.6	48	800	14.5	37	754	12.2	32	710	9.3	31	628	2.9	28	554	-4.0	23
Chicago, Ill. ² (187 m)	30	994	16.5	83	958	18.0	65	903	15.5	65	851	12.2	69	802	9.4	66	754	6.7	63	709	4.3	54	626	-1.0	40	552	-7.1	30

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

¹ Army.

² Weather Bureau.

³ Navy.

* Observations by radiometeorograph. Stations not so marked have observations by airplane.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during June 1938

[Wind from N=360°, E=90°, etc.]

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,068 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (157 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (283 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Nashville, Tenn. (194 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	351	0.6	267	0.4	270	1.6	258	1.4	265	2.0	235	1.2	103	0.2	250	1.3	137	1.4	153	1.0	121	1.7	235	0.3	223	5.2
500	---	---	234	1.7	---	---	270	5.1	---	---	235	3.8	220	2.1	248	2.7	108	2.9	186	7.1	120	3.4	273	1.1	237	2.3
1,000	---	---	251	3.2	---	---	283	4.7	---	---	258	4.3	254	3.4	257	3.6	248	1.8	184	6.7	127	2.7	308	2.5	248	3.8
1,500	---	---	254	3.7	273	1.7	269	4.1	---	---	262	4.2	265	4.1	260	5.1	247	3.4	186	5.4	136	1.6	338	1.6	254	4.4
2,000	138	1.8	254	3.7	285	2.6	263	4.2	241	3.7	274	5.3	275	5.9	261	5.4	293	4.6	186	4.2	146	0.8	14	2.5	255	5.3
2,500	217	2.2	266	4.6	263	3.8	273	4.5	239	5.2	286	4.6	300	5.2	260	5.9	303	5.5	190	2.9	212	0.8	10	1.7	285	6.4
3,000	241	2.9	280	5.2	268	5.2	288	5.4	247	5.6	299	6.5	294	6.2	286	4.7	299	6.0	190	1.7	200	2.0	290	2.5	262	6.4
4,000	230	3.9	292	4.9	261	6.1	268	6.8	268	6.6	312	6.8	311	5.5	307	6.2	298	6.4	318	0.6	205	2.3	293	3.8	256	5.1
5,000	242	5.3	303	5.2	247	8.5	---	---	261	5.9	---	---	---	---	307	6.9	---	---	337	1.0	252	3.5	292	3.8	276	5.7

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during June 1938—Continued

Altitude (meters) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Har- bor, Territ- ory of Hawaii ¹ (88 m)		Pensacola, Fla. ¹ (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,292 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washing- ton, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	331	1.1	256	2.0	152	2.0	161	1.9	-----	-----	328	1.2	238	0.8	152	2.2	233	1.1	254	0.5	149	1.4	83	1.4	271	0.4
500.....	308	4.2	238	2.7	167	4.3	187	4.7	-----	-----	282	2.2	261	2.5	-----	-----	204	0.5	295	2.6	12	1.3	-----	-----	321	2.8
1,000.....	308	3.8	314	5.5	200	7.5	213	5.6	-----	-----	268	2.6	286	3.0	-----	-----	344	0.6	272	4.4	24	1.4	217	0.5	319	3.1
1,500.....	296	4.1	323	3.9	219	5.6	235	5.1	-----	-----	271	3.6	282	3.2	137	1.9	-----	-----	271	5.1	318	1.4	266	1.3	316	3.5
2,000.....	287	3.9	322	4.0	244	4.0	259	5.6	-----	-----	281	3.9	283	4.2	170	1.3	-----	-----	261	6.4	291	1.8	252	2.3	302	2.9
2,500.....	304	3.2	318	3.5	273	4.5	276	5.8	-----	-----	288	5.0	287	4.9	206	1.8	-----	-----	271	6.0	265	2.0	250	2.6	280	4.0
3,000.....	315	2.5	269	2.0	289	3.7	279	6.7	-----	-----	296	4.3	284	5.6	244	3.1	-----	-----	292	5.6	251	3.4	252	4.0	306	7.9
4,000.....	37	3.7	293	4.7	316	3.3	292	6.4	-----	-----	304	3.5	328	6.7	252	5.9	-----	-----	306	6.4	-----	-----	257	5.4	296	5.2
5,000.....	-----	-----	248	6.8	-----	-----	-----	-----	-----	-----	-----	-----	347	5.4	244	9.1	-----	-----	295	5.5	-----	-----	263	6.9	-----	-----

¹ Navy stations.

TABLE 3.—Maximum free-air wind velocities, (meters per second) for different sections of the United States based on pilot-balloon observations during June 1938

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum ve- locity	Direction	Altitude (m), m. s. l.	Date	Station	Maximum ve- locity	Direction	Altitude (m), m. s. l.	Date	Station	Maximum ve- locity	Direction	Altitude (m), m. s. l.	Date	Station
Northeast ¹	34.0	W.....	1,750	7	Buffalo, N. Y.....	36.3	W.....	5,000	8	Cleveland, Ohio.....	36.8	W.....	5,200	8	Cleveland, Ohio.
East-Central ¹	26.4	SW.....	2,230	11	Cincinnati, Ohio.....	24.6	W.....	3,930	5	Richmond, Va.....	40.0	WNW.....	11,070	8	Nashville, Tenn.
Southeast ¹	20.3	WSW.....	630	21	Jacksonville, Fla.....	20.4	W.....	4,660	12	Spartanburg, S. C.....	20.9	WSW.....	9,160	9	Spartanburg, S. C.
North-Central ¹	32.7	NW.....	1,870	1	Bismarck, N. Dak.....	38.0	SW.....	2,630	7	Detroit, Mich.....	31.5	WNW.....	8,110	8	Fargo, N. Dak.
Central ¹	36.0	W.....	1,960	6	Indianapolis, Ind.....	30.8	WSW.....	3,690	10	Moline, Ill.....	32.0	W.....	11,070	17	Moline, Ill.
South-Central ¹	33.1	S.....	1,710	10	Abilene, Tex.....	27.6	W.....	4,070	26	New Orleans, La.....	25.0	N.....	7,850	5	Houston, Tex.
Northwest ¹	29.9	W.....	2,500	8	Missoula, Mont.....	37.0	W.....	4,720	8	Boise, Idaho.....	43.5	NNE.....	6,080	19	Medford, Oreg.
West-Central ¹	63.3	S.....	2,470	19	Modena, Utah.....	58.0	S.....	2,500	19	Modena, Utah.....	41.6	WSW.....	6,300	17	Reno, Nev.
Southwest ¹	27.3	NNW.....	1,990	13	Sandberg, Calif.....	46.2	WSW.....	3,200	9	Winslow, Ariz.....	40.8	W.....	11,660	16	Las Vegas, Nev.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.² Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.³ South Carolina, Georgia, Florida, and Alabama.⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.⁷ Montana, Idaho, Washington, and Oregon.⁸ Wyoming, Colorado, Utah, northern Nevada, and northern California.⁹ Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

RIVERS AND FLOODS

(River and Flood Division, MERRILL BERNARD in charge)

By BENNETT SWENSON

Severe floods occurred during June 1938, principally in the Neosho, Smoky Hill, and Osage Rivers in Kansas. Excessively heavy local showers in Montana caused disastrous, sudden floods in that State with great property damage amounting to nearly \$1,000,000 and the loss of about 58 lives, 48 of which were lost in the train wreck caused by a flood in Custer Creek, which flows into Yellowstone River about 30 miles below Miles City, Mont. High water in the San Joaquin and Columbia River basins caused considerable overflowing in those basins. A number of other floods, mostly of a minor character, also occurred with no damage of great consequence. Flood heights at all of the gaging points are shown in the accompanying table.

The following report on the floods in the Topeka, Kans., river district is submitted by the official in charge at that place:

Four overflows occurred in the Neosho River in Kansas during the month and the month preceding, one along the upper Smoky Hill, one along the Osage, one in the upper Solomon, and one in the Saline River. The first overflow of the Neosho was one that started in May and which began at Le Roy and Iola, Kans., on May 20 and by the 22d extended along the entire river below

Emporia, Kans. This was preceded by a slight overflow at Le Roy on May 13 and at Iola and Chanute, Kans., on May 14. At Neosho Rapids and Le Roy the serious May overflow had subsided by May 26 and 29, respectively, but from Iola to the Oklahoma line it continued into June. At Oswego, Kans., where the crest was 23.5 feet, 6.5 feet above bankful, on June 1, the river did not return to its banks until June 6, making a total of 15 days for the overflow at that place. While crest stages did not approach previous records at any place, the duration of this overflow caused great damage to growing crops, estimated at \$342,500, with 145,000 acres flooded. The total property loss was estimated at \$410,350. One life was lost, though not directly due to the high water.

A slight overflow of the Neosho occurred at Le Roy on June 1 and at Iola on June 1 and 2 but caused little damage.

Another overflow of the Neosho occurred in Labette County, beginning June 17. This reached a crest of 24.0 feet, 2.0 feet above bankful, at Parsons, Kans., on the 17th and 21.8 feet, 4.8 feet above bankful, at Oswego on the 18th. Damage from this overflow totalled \$28,000, being mostly to crops and livestock.

Heavy rains that totalled 5.33 inches at Council Grove, Kans., fell along the upper reaches of the Neosho River on June 10 and resulted in a disastrous overflow in that city and downstream to the junction of the Neosho with the Cottonwood River. Damage from this overflow was estimated at \$314,806 the greater part of which was to property in Council Grove, and to growing crops. At Neosho Rapids, just below the mouth of the Cottonwood River, the highest stage measured was 22.8 feet, 0.8 foot above bankful, on the evening of the 12th, at which time the river was believed to